3M

Product Information

Novec™ Engineered Fluid HFE-7200

Introduction

3M™ Novec™ Engineered Fluid HFE-7200, ethoxy-nonafluorobutane ($C_4F_9OC_2H_5$), is a clear, colorless and low-odor fluid intended to replace ozone-depleting and chlorinated materials in many applications. Its physical properties are compared with several other ODS replacement fluid candidates in Tables 1 and 2.

This proprietary fluid has zero ozone depletion potential and other favorable environmental properties (see Table 2). It is low in toxicity, with a time-weighted average exposure guideline of 200 ppm (eight hour average).

Novec fluid HFE-7200 has a higher boiling point than most CFCs, HCFCs and HFCs, reducing evaporative losses. The low surface tension and low viscosity of HFE-7200 fluid make it ideal for use in vapor degreasing and cold cleaning applications. In addition, its chemical and thermal stability, nonflammability and low toxicity make it useful for other industrial applications such as specialty solvent and heat transfer applications (see below).

Typical Applications

- Cold cleaner (movie film, wipe solvent)
- Cleaning and rinsing agent for vapor degreasing
  - Light-duty cleaning (neat)–particulates, fluorolubes, light oils, fluoropolymers
- Lubricant carrier
  - Fluorocarbons
  - Hydrocarbons
  - Silicones
- Specialty solvents, dispersion medium, reaction medium, extraction solvent
- Spray contact cleaner
- CFC, HCFC, HFC and PFC replacement agent

Material Description

Ethoxy-nonafluorobutane[1]	99.0% minimum
Appearance	Clear, colorless
Non-volatile residue (NVR)	1.0 ppm maximum

[1] HFE-7200 fluid ($C_4F_9OC_2H_5$) consists of two inseparable isomers with essentially identical properties. These are $(CF_3)_2CFCF_2OC_2H_5$ (CAS No. 163702-06-5) and $CF_3CF_2CF_2CF_2OC_2H_5$ (CAS No. 163702-05-4).

3M™ Novec™ Engineered Fluid HFE-7200 Properties – Table 1

Data compiled from published information

Not for specification purposes

Properties	HFE-7200	HFE-7100
Formula	$C_4F_9OC_2H_5$	$C_4F_9OCH_3$
Molecular Wt.	264	250
Boiling Pt. °C	76	61
Freeze Pt. °C	-138	-135
Liquid Density[1]	1.43	1.52
Surface Tension[2]	13.6	13.6
Solubility of Solvent in Water[3]	<20	12
Solubility of Water in Solvent[3]	92	95
Vapor Pressure[4]	109	202
Viscosity[5]	0.61	0.61
Heat of Vaporization[6]	30	30
Specific Heat[7]	0.29	0.28

[1] g/ml @ 25°C [2] dynes/cm @ 25°C [3] ppm by weight [4] mm Hg @ 25°C [5] cps @ 25°C [6] cal/g @ b

Environmental Properties and Exposure Guidelines – Table 2

Data compiled from published information

Not for specification purposes

Properties	HFE-7200	HFE-7100
Ozone Depletion Potential[1]—ODP	0.00	0.00
Global Warming Potential[2]—GWP	55	320
Atmospheric Lifetime—ALT (yrs)	0.77	4.1
Flashpoint	None	None
Flammability Range in Air	2.4–12.4%	None
Exposure Guidelines (8 hr. time-weighted average)	200 ppm	750 ppm
Acute Toxicity (4 hr. LC_{50} [Rat])	>92,000 ppm	>100,000 ppm

[1] CFC-11 = 1.0 [2] GWP–100 year Integration Time Horizon (ITH) *Note: HCFC-225 ca/cb ratio is 45/55*

Vapor Pressure and Density

The variation of vapor pressure and density with temperature for Novec engineered fluid HFE-7200 can be calculated using the following formulas:

Vapor Pressure: $\ln P = 22.289 - 3752.1\ [1/(t+273)]$

Density: $D = 1.4811 - 0.0023026t$

P = Vapor Pressure in Pascals
t = Temperature in °C
D = Density in g/ml

PF-5070	HFC-4310	HCFC-225 ca/cb	nPB	1,1,1-TCA
C_7F_{16}	$C_5H_2F_{10}$	$C_3Cl_2HF_5$	C_3H_7Br	CH_3CCl_3
388	252	203	123.0	132
80	54	54	71	74
-95	-80	-131	-110	-39
1.73	1.58	1.55	1.35	1.32
13.0	14.1	16.2	25.9	25.1
<5	140	330	2400	700
11	490	310	500	170
79	226	290	110.8	121
0.95	0.67	0.59	0.49	0.83
19	31	34.6	58.5	58
0.25	0.27	0.24	0.27	0.25

oiling point [7] cal/g °C @ 25°C

PF-5070	HFC-4310	HCFC-225 ca/cb	nPB	1,1,1-TCA
0.00	0.00	0.03	0.026	0.1
8400	1700	180/620	0.31	140
2300	17.1	2.1–6.2	0.03	4.8
None	None	None	None	None
None	None	None	4–7.8%	6–15%
Not determined	200 ppm (400 ppm ceiling)	50 ppm	Pending	350 ppm
Not determined	11,000 ppm	37,000 ppm	7000 ppm	18,000 ppm

Environmental Health and Safety

Before using this product, please read the current product Material Safety Data Sheet (available through your 3M sales or technical service representative) and the precautionary statement on the product package. Follow all applicable precautions and directions.

HFE-7200 fluid is nonflammable and does not exhibit flammability characteristics under normal operating and storage conditions. This fluid is highly resistant to thermal breakdown and hydrolysis in storage and during use. Recommended handling procedures are provided in the pertinent Material Safety Data Sheet, which is available from your local 3M representative upon request.

Materials Compatibility

3M™ Novec™ Engineered Fluid HFE-7200 is compatible with a wide range of metals, plastics and elastomers, similar to the performance of 3M™ Novec™ Engineered Fluid HFE-7100 and perfluorinated liquids.

Good compatibility with particularly sensitive plastics such as polycarbonate and PMMA indicates utility in cleaning of assemblies containing many composite materials.

As with most fluorinated liquids, HFE-7200 fluid will absorb into fluorinated plastics and elastomers over longer exposures.

Metals	Plastics	Elastomers
Aluminum	Acrylic (PMMA)	Butyl Rubber*
Copper	Polyethylene	Natural Rubber
Carbon Steel	Polypropylene	Nitrile Rubber
302 Stainless Steel	Polycarbonate	EPDM
Brass	Polyester	
Molybdenum	Epoxy	
Tantalum	PET	
Tungsten	Phenolic	
Cu/Be Alloy C172	ABS	
Mg Alloy AZ32B		

Compatible after one hour exposure at boiling temperature.

Exceptions: *Some swelling of PTFE and Silicone Rubber. Some surface oxidation of copper during heat aging.*

**Butyl Rubber best for extended exposure >1 month.*

Environmental Policy

3M will continue to recognize and exercise its responsibility to prevent pollution at the source wherever and whenever possible; develop products that will have a minimal effect on the environment; conserve natural resources through the use of reclamation and other appropriate methods; assure that its facilities and products meet and sustain the regulations of all federal, state and local environmental agencies; assist, wherever possible, governmental agencies and other official organizations engaged in environmental activities.

Packaging and Availability

Novec fluid HFE-7200 may be ordered in the following container sizes:

- 55-gallon drum; 5-gallon pail; 1-gallon pail
- 4-ounce samples for limited or preliminary test work are available

3M™ Novec™ Engineered Fluid HFE-7200 Regulatory Status

Novec fluid HFE-7200 has been accepted for commercial use by regulatory agencies in the United States, Canada (less than 10,000 lbs/yr), Japan, the Philippines (less than 2,000 lbs/yr) and Europe. The components of HFE-7200 fluid have been nominated to China's draft chemical inventory.

Novec HFE-7200 fluid has been approved under the Significant New Alternatives Policy (SNAP) of the U.S. EPA. Novec fluid HFE-7200 has been excluded by the U.S. EPA from the definition of a VOC on the basis that this compound has negligible contribution to tropospheric ozone formation. In addition, the South Coast Air Quality Management District (SCAQMD) has certified HFE-7200 fluid as a Clean Air Solvent.

Contact your local 3M representative regarding the regulatory status of HFE-7200 fluid in other countries.

Toxicity Profile

The toxicological testing completed on Novec engineered fluid HFE-7200 shows the overall toxicity is low. The material is minimally irritating to the eyes, non-irritating to the skin and is not a mutagen. This material is rated "practically non-toxic" through inhalation. A twenty-eight day inhalation study has helped establish a recommended exposure guideline of 200 ppm for an eight-hour average worker exposure per day.

Toxicological Test Results

Properties	HFE-7200
Acute Lethal Inhalation Concentration	>92,000 ppm (4 hour)
Oral	Practically non-toxic (>5g/kg)
Eye Irritation	Minimally irritating
Skin Irritation	Non-irritating
Skin Sensitization	Not a skin sensitizer
Inhalation (28 day study)	200 ppm exposure guideline[1] Detailed results are available
Developmental Toxicity	Detailed results are available
Mutagenicity	Not a mutagen
Cardiac Sensitization	No signs at exposure up to 20,000 ppm
Ecotoxicity Testing	Complete–low aquatic toxicity

[1] Exposure Guideline set by the 3M Medical Department

Used Fluid Return Program

3M offers a program for free* pickup and return of used 3M specialty fluids in the U.S. through Safety-Kleen Corp. A pre-negotiated handling agreement between users and this service provider offers users broad protection against future liability for used 3M product. The fluid return program is covered by independent third-party financial and environmental audits of treatment, storage and disposal facilities. Necessary documentation is provided. A minimum of 30 gallons of used 3M specialty fluid is required for participation in this free program.*

Safety-Kleen Corp. has a network of 156 branch service centers in the U.S. This large fleet will provide timely, economical fluid disposal service.

For additional information on the 3M Used Fluid Return Program, contact Safety-Kleen at this toll-free line: 1.888.932.2731. Contact your local 3M representative for fluid return programs outside the U.S.

* Must have a 30 or more gallon purchase to participate in the 3M paid program. Used product of 5-30 gallons can be returned through Safety-Kleen at the user's expense.

Resources

3M™ Novec™ Engineered Fluids are supported by global sales, technical and customer service resources, with fully-staffed technical service laboratories in the U.S., Europe, Japan, Latin America and Southeast Asia. Users benefit from 3M's broad technology base and continuing attention to product development, performance, safety and environmental issues.

For additional technical information on Novec fluid HFE-7200 in the United States, call 3M Performance Materials Division, 800.833.5045.

For information on additional 3M fluids, coatings and other chemical products for the electronics industry, visit our web site at: www.3m.com/fluids

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